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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[a]

EXTENSION OF RICE CULTURE.[b]

Rice production in this country and the acreage allotted to the crop has in recent years undergone an enormous increase. As pointed out by the Twelfth Census, only 161,312 acres were grown in 1889 and 342,214 acres in 1899, while according to statistics gathered by this Department the area devoted to the crop in 1905 was 482,479 acres and the total production for the year amounted to 13,606,989 bushels. The first rice was grown in the United States about the middle of the seventeenth century, and the crop was introduced into South Carolina toward its close. For years our rice culture was limited to certain sections along the South Atlantic coast, until within recent years some of the prairie lands of Louisiana and Texas were opened up to the culture of the crop.[c] During the last four or five years a good beginning in rice culture has also been made in Arkansas, with results indicating the possibility of widely extending the area of profitable rice culture on lands not hitherto considered adapted to this crop.

In 1902 the Arkansas Experiment Station, in cooperation with a farmer who conceived the idea of growing rice on Arkansas prairie lands, introduced rice culture on a limited scale in Lonoke County, a little southeast of the center of the State. A good stand was obtained from the first sowing, and the result secured demonstrated that the crop can be successfully grown on these prairie lands when proper irrigation facilities are provided.

The following year the station, in cooperation with the Irrigation and Drainage Investigations of the Office of Experiment Stations of this Department, sank a well, installed machinery, and constructed levees to put a greater area under irrigation. In 1904 10 acres were grown, and although the crop was not sown until late it was successful from the beginning, one plat yielding as high as 75 bushels per

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Arkansas Sta. Buls. 89 and 94.

[c] See also U. S. Dept. Agr., Farmers' Bul. 110, Rice Culture in the United States, by S. A. Knapp.

acre. In 1905 the area was increased to 30 acres, but owing to unfavorable weather conditions only 25 acres were harvested. About 17 acres of Honduras rice yielded 53 bushels and about 8 acres of Japan 67.53 bushels per acre, the average for the two varieties being 57.8 bushels.

In 1906 the acreage of rice was greatly increased over that of previous years. The industry had extended from Lonoke to Prairie, Arkansas, Lee, and St. Francis counties, and the total area devoted to the crop was about 5,000 acres. The total production was estimated at over 100,000 bushels. The season was in many respects very unfavorable for growing rice, yet where the soil was well prepared, the crop planted early, irrigated properly, and harvested at the right time the yield was satisfactory. A rain and wind storm on September 23, when the late planting had not yet been harvested, damaged the crop from 5 to 12 per cent, and still greater injury was sustained from an early frost in October. Much of the loss was due to late sowing, on account of heavy rains, and also the result of showers during the period of pollination.

For the experiment station crop in 1906 is was impossible to plow the land early on account of heavy rains in the fall and winter of 1905, and it was not until April 16 that the stubble was turned and not until April 28 that the land was finished. The ground was very rough and cloddy and it was necessary to disk it three times and to smooth it down with the harrow. The seed was sown broadcast at the rate of from 1¼ to 1½ bushels per acre, then disked in and crossed with a smoothing harrow. The first sowing was made April 20 and the maximum yield, 77.76 bushels per acre, was harvested from that plat.

The Honduras variety produced at the rate of 61.84 bushels and the Japan 52.44 bushels per acre, the average being 57.5 bushels. The irrigation period of this crop was eighty-four days. Contrary to the experience of the two preceding years, Honduras rice produced the maximum yield, probably owing to the fact that the Japan plats were all planted much later and therefore suffered from storms, cool nights, and early frosts. Where the two varieties were sown on sod land under the same conditions Japan made a much better yield. Honduras rice is named for the country from which the seed came, and Japan, a hardy variety, was recently introduced from that country by this Department. These two varieties, which are the only kinds now planted in Arkansas, are briefly described as follows:

The Japan has a short, thick kernel, a thick hull, and heavy grain. It is not so tall as the Honduras, and the straw is smaller and green when the grain is ripe. The percentage of bran in the Japan is small. Since the grains do not break so badly it will mill more head rice than the Honduras. The market price for Japan, however, is a little less than for Honduras, but the yield is greater.

The Honduras has a large grain, a tall, stiff stalk, and is not so easily blown down. Both varieties have their advantages and disadvantages. Our experi-

ments, based upon two years' tests, proved that Japan is well adapted to our soil and climate. Japan may be planted later than Honduras with good results.

The character of the soil of the Prairie Longue and Grand Prairie regions of Arkansas, which have been found especially adapted to rice culture, are thus described:

The low, level character of the land, the stiff texture, and impervious subsoil are peculiarly favorable to holding water during irrigation, thus economizing the amount necessary. The ground dries immediately after the water has been turned off, so the binder and team will pass over it. An abundant supply of pure water can be secured from wells ranging in depth from 100 to 200 feet. The geological formation is such that the lift is not usually more than from 20 to 40 feet. Delta lands of the Mississippi and those of the rivers of the Carolinas and Georgia produce a fine grade of rice, which reaches the market early and brings fancy prices. However, in many cases these lands are not adapted to the use of the improved machinery, consequently the expense of growing the crop is greater than that of the prairie lands.

The alluvial lands of south Arkansas are in many places adapted to rice culture. Pure warm water, with nitrates and other soluble plant food, can be taken from lakes, ponds, bayous, and rivers at very little expense.

It is stated that the lands which are now devoted to rice are lands that, owing to lack of drainage and reclamation, were not adapted to other field crops and were almost exclusively used for grazing. A farmer planted 40 acres of bottom land lying adjacent to Bearskin Lake with rice in order to determine whether irrigation would kill nut grass, which was very abundant in the field, and at the same time produce a crop of rice. The experiment was successful and an average yield of 46½ bushels of rice per acre was secured.

The time of planting largely depends upon the season, but it is recommended that for southern Arkansas the crop be planted as soon as all danger of frost is over and the ground warm enough to germinate the seed, which will usually be from April 1 to May 15. Honduras should be planted earlier than Japan, which may be sown any time until May 15.

So far few insect pests and fungus diseases and no noxious weeds, except red rice, have appeared in the rice fields of the State.

Red rice, according to Dr. S. A. Knapp, "is so called from the red color of the grains. In most cases the grain is colored a dark red through the entire substance. In other instances seeds may present any shade of color between the red and the white; again, only the seed coat contains the coloring matter, and in this case the grain comes from the mills clean and white, or with little stripes of red where the coat has been imperfectly removed." The presence of a few grains of red rice in milled rice lowers its grade and reduces its price. It is, therefore, important to keep red rice out of rice fields.

In order to keep red rice from the rice field it is advised to grow a few acres isolated and planted on sod or new land for seed, and to select the largest, earliest, and best heads for the next crop. When red rice appears the field should be plowed, disked, and harrowed as soon as the crop is harvested. If the land is dry and hard, flooding will germinate many of the seeds, which will then be killed during the winter. Other seed germinating in the early spring may be killed by spring plowing. When red rice has obtained a firm hold in the field, some other crops should be grown until the weed has disappeared, and if the land is too low and acid to produce good crops, it may be fall plowed and left in fallow until spring, plowed again, fallowed until midsummer, and then plowed for a crop of rice.

Suggestions regarding methods of culture adapted to Arkansas conditions are given in the bulletins from which this article is compiled.[a]

GROWING SEED POTATOES UNDER MULCH.[b]

R. A. Emerson, of the Nebraska Experiment Station, has reported an interesting comparison of the value for seed purposes of potatoes grown under mulch with those grown with ordinary cultivation under like conditions, which indicates that the mulch method offers a convenient and practical means of producing good home-grown seeds under Nebraska conditions. The theory of the method and the results obtained in the comparative tests are thus stated:

Potatoes are a cool-weather crop. It is because of this that they succeed so well in the far north. Moreover, potatoes require for their best development fairly uniform conditions, especially as regards soil moisture and soil temperature. This being the case, why should not potatoes grown under a litter mulch be especially well developed and therefore make strong seed? The soil beneath a mulch not only has a moderately low temperature during summer, but its temperature is also exceptionally uniform, varying not more than a degree or two between day and night and only a few degrees from day to day. The soil moisture beneath a good mulch is also more abundant and much more nearly uniform in amount than in case of bare ground, even though the latter is given good tillage.

The value for seed purposes of tubers grown under a litter mulch has been tested during two seasons at the experiment station. In 1904 a plat of potatoes was mulched with straw and an adjoining plat was given careful cultivation. The soil of the two plats was practically uniform and the seed planted on the two plats was taken from the same lot of tubers. Seed was saved from the mulched and cultivated plats separately, kept under the same conditions during winter, planted on adjoining plats in the spring of 1905, and given identical cultivation during the summer. In 1906 the experiment was repeated with seed grown in mulched and in cultivated ground the year before. The same precautions were observed as in the first test. Uniform seed was used to start

[a] See also U. S. Dept. Agr. Farmers, Bul. 110.

[b] Compiled from Nebraska Sta. Bul. 97.

with in 1905. The seed saved from the mulched and from the cultivated plats was taken as it came, without selection, and was kept over winter under the same conditions. Both kinds of seed were cut in the same way, planted in the same way, on adjoining plats, and treated alike as regards tillage, spraying, etc. Under these conditions any constant differences in yield between the two plats must be ascribed to the effect of the methods of culture employed the previous season. The yields obtained from the mulched and from the cultivated seed were as follows: Cultivated seed, 384 pounds in 1905; mulched seed, 563 pounds in 1905; cultivated seed, 123 pounds in 1906; mulched seed, 174 pounds in 1906.

The use of seed that had been grown under a mulch the preceding year increased the yield of potatoes 47 per cent in 1905 and 41 per cent in 1906. If further tests confirm the results reported here, it would seem that mulching might be used for the production of high-grade seed potatoes at home. Moreover, mulching usually results in increased yields if properly handled. Mulching potatoes on a large scale is of course impracticable, but most farmers could easily mulch enough of their potato field to produce the seed that they would require the following year, and in doing so they would not necessarily increase the cost of production per bushel.

The method migh be tried with advantage in other regions than Nebraska, where warm, dry seasons prevent the production of vigorous seed by ordinary methods.

MANURE AS A SUMMER MULCH IN FORCING HOUSES.[a]

In experiments made by G. E. Stone, of the Massachusetts Experiment Station, it was found that the practice common among those engaged in forcing vegetables under glass of allowing the soil of beds to become very dry during that portion of the season when the houses are not in use has an injurious effect on the growth of lettuce by increasing the activity of the "drop" fungus in the soil and the extent of infection in the succeeding crop of lettuce. Other injurious effects were also observed which were "manifested in a stunted growth and abnormally colored and worthless crop." Doctor Stone therefore recommends that the soil of houses used for forcing lettuce should never be allowed to become too dry in summer, and explains that "if such drying occurs the soil can be entirely renovated by applying hot water or steam to it."

The Ohio Station reports experiments begun three years ago to determine "what effect the use of strawy manure would have on the soil when used as a mulch during that part of the summer when crops are not growing in the greenhouses," which gave results bearing upon the question of the advantage of keeping greenhouse soils moist in summer.

The manure was applied as soon as the tomato and cucumber vines were removed from the houses, or about the first of August. It was put on to a depth of from 5 to 6 inches and spread evenly over the entire surface of the beds. As soon as it was on, water was applied in the form of a spray until the manure and soil were thoroughly wet.

[a] Compiled from Ohio Sta. Circ. 69.

The object of this wetting was, first, to leach the fertility of the manure into the soil, and, second, to wet the soil sufficiently so that with the strawy mulch it would remain moist for several days. The operation of watering was repeated as often as needed; two or three times a week in bright weather.

When it came time to plant the lettuce, about the middle of September, the coarse part of the manure was removed from the beds and carried outside. The finer portion of the manure was worked into the soil at the time of spading.

It was noticeable that the soil which had been treated with the mulch was in excellent mechanical condition when it was worked up for the first crop. There were no lumps, as there often are in soil which has been allowed to bake in the sun for weeks at a time. It was also darker in color than unmulched soil. The lettuce plants which were planted in this soil started off nicely and grew rapidly and satisfactorily in every respect. No further application of manure or fertilizer of any kind was made for the second and third crops of lettuce. The growth of these crops was very satisfactory, as was that of the first crop.

The method gave such favorable results at the station that a practical grower of forcing-house vegetables was induced to try it.

Taking the results of the station tests for the two seasons, together with the results secured by the [practical grower] for the same length of time and gleaning what information it has been possible to obtain from various sources, the station does not hesitate to recommend this treatment for soils which are to be used for vegetable forcing. It must be borne in mind, however, that no half-way or slipshod methods of using the mulch will give satisfactory results. There should be sufficient fertility in the manure to furnish enough plant food, when leached into the soil, to supply the three crops of lettuce. The quantity of manure must be sufficient, also. At least 5 or 6 inches should be applied. A considerable quantity of coarse material in the manure, such as straw, corn stover, etc., is an advantage. Fresh manure has been used at the station each time, and, while we have had no chance to see the effect of the use of the well-rotted manure, we are satisfied with fresh manure, as we know that it will give good results.

Where it is the practice to mulch the cucumber or tomato crop, the manure used for that purpose can be left on and more added, provided the cucumbers or tomatoes have been free from disease. In case these crops have been diseased, it would be advisable to remove the mulch used on them and apply new.

Frequent sprinkling of the manure on the beds is very essential.

When it comes time to put in the first crop, if the soil is in need of humus, the entire mulch may be spaded into the soil, but most greenhouse soils do not need the addition of so much coarse material. Where the soil is fairly well supplied with humus, the coarser part should be taken off and removed from the houses and the finer portion worked into the soil.

The fact that the greenhouses in which the mulch was used were very free from lettuce disease "would lead us to expect beneficial rather than detrimental results from the proper use of summer mulch in so far as it affects the diseases of lettuce." If the use of mulch has any beneficial effect as regards diseases, it is entirely a preventive measure and not a cure. Neither this method nor any other will prevent damage which results from bad methods of handling the crop.

RENEWAL OF OLD ORCHARDS.[a]

F. H. Ballou, of the Ohio Experiment Station, maintains that old neglected orchards, which have been overgrown with weeds and brambles and have become not only worthless but a menace to new, well-cared-for orchards, may be "renewed" so that they may be a valuable source of fruit, especially while new orchards are coming into bearing.

Instead of these orchards being destroyed to prevent the spread of diseases and noxious weeds to newly planted orchards he explains how they may be renewed in such a way that the injurious insects and diseases may be effectually and easily combated and controlled, and the old trees made to produce fine fruit for home and market while the young fruit trees are growing.

Mr. Ballou explains at the outset that "renewal is a reversal of the generally prevailing idea of 'pruning up' old trees. It is distinctly a process of 'pruning down.'"

The type of trees with which renewal is not practicable is that type whose heads have been formed at an extreme height from the ground, and whose naked branches, from that elevated point of divergence, extend many more feet upward and outward with no intervening smaller branches. Usually a tree that was originally headed moderately low, and whose lower branches are in good condition, can be successfully renewed.

Cut out the topmost branches the first season of renewal, leaving all healthy side branches. The next season these horizontal branches may have their extremities lopped back with the pruners in such a way as to promote a uniform, well rounded, symmetrical head or top.

It will be necessary to saw large branches first on the under side, then on the upper side, a few inches farther out or up the branch in the direction of its growth. This allows the branch to break off without splitting the part remaining. A second cut, at an angle, can then be made without difficulty, leaving a smooth, clean-cut stub.

All wounds should be dressed, a few weeks after cutting, with a thick paint made of pure white lead and boiled linseed oil.

The benefits of heading back will be lost, in time, unless the work be followed up by annual, discriminate thinning of the new shoots, and cutting back of those selected for future fruit bearing.

Renewal of orchards may profitably be accompanied by the addition of stable manure, either worked into the soil beneath the extremities of the branches, or allowed to remain upon the surface to be covered later with straw or other coarse material applied as a mulch. The combination of renewal and fertilization will work wonders in the rejuvenation of many old orchards long considered unprofitable and valueless.

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[a] Compiled from Ohio Sta. Bul. 180. See also U. S. Dept. Agr., Farmers' Bul. 169, p. 16.

INJURY BY BORDEAUX MIXTURE.[a]

While it is recognized that Bordeaux mixture is the most efficient fungicide now known for combating many diseases of fruit, particularly those of the apple, evidence has been collected by the New York State Station which shows that it is not a perfect application for use in apple orchards, since under certain conditions the mixture itself, even when made and applied with extreme care, may spot the leaves and mark or deform the fruit.

On the foliage, Bordeaux injury greatly resembles the leaf spot supposed to be caused by fungi. Dead, brown spots first appear, which may be small, circular or roundish, or larger and of irregular shape as though several small spots had run together. The living and dead tissue are separated by a distinct line, so that the spotting is very conspicuous. Later, if the injury is severe, the leaf turns yellow over more or less of its surface and finally drops off as in natural falling. Many of the orchardists reporting place the amount of defoliation during 1905 at one-half or more of the leaves; while in a few instances nearly all of the first leaves fell.

On the fruit the injury first appears as minute, round, black, or brown spots or specks, less than pin-head size, which are clustered either (1) at the apex of the fruit if the injury results from spraying before the little fruits have turned down, or (2) at the base of the fruit if the injury results from later sprayings. Subsequently the characteristic "spray russeting" or "cork russeting" appears. The plant cells injured by the spray form thick, corky tissue, which roughens or russets the apple, the extent of the marking varying with individual fruits. These characters give the fruit the appearance of having been attacked by a fungus. Brightly colored fruit is much marred, both by the russeting and by a decreased brilliance of the unspotted areas. Badly injured specimens are always more or less distorted in shape, the affected areas being usually shrunken. Occasionally unsightly, teat-like malformations are produced, or gaping cracks in half-grown fruits which heal over as the fruits develop, leaving rough sunken scars.

These injuries affect the keeping qualities of the fruits to a marked extent, the moisture being rapidly given off, in dry rooms or cellars, through the corky tissue, so that the flesh below shrivels or becomes mealy, or in extreme cases may turn brown as if bruised or exposed to the air. In such cases decay sets in rapidly. With late-keeping apples this phase of the injury is very important, as the keeping quality is affected, no matter how slight the russeted area.

In cold storage the depreciation of russeted apples is not very rapid, but such fruit is not wanted by retailers, as it keeps very poorly when brought from storage into a dry atmosphere.

Certain injuries to foliage and fruit may be confused with Bordeaux injury, though usually there are points of difference easily separating them.

A perfect method of preventing the injury has not been devised, but U. P. Hedrick and F. H. Hall, of the New York State Experiment Station, give the following suggestions which will aid in reducing it:

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[a] Compiled from New York State Sta. Bul. 287.

(1) Distinguish, in spraying, between varieties very susceptible to spray injury and those resistant or less susceptible. Among such susceptible varieties, which must be sprayed with great care, are: Baldwin, Ben Davis, Gravenstein, Jonathan, Rhode Island Greening, Twenty Ounce, Wagener, Wealthy, Yellow Newton, Yellow Transparent. Among those less susceptible are: Alexander, Esopus Spitzenburg, Fall Pippin, Hubbardston, Northern Spy, Red Astrachan, Red Canada, Rome, Roxbury, Tolman Sweet, Tompkins King, Yellow Bellflower.

(2) Varieties resistant to scab should receive light applications of Bordeaux, especially if they are very susceptible to injury by the copper sulphate. Among such scab resistant varieties are: Alexander, Ben Davis, Gano, Hubbardston, Oldenburg, Red Astrachan, Rome, Roxbury, Sutton, Tompkins King, Tolman Sweet, Wealthy, Yellow Newton, and Yellow Transparent.

(3) It will probably be best to use less copper sulphate. On this point it is not possible at present to speak positively. * * *

(4) An excess of lime will not prevent Bordeaux injury nor greatly lessen it; therefore it is not advisable to use more than one part of lime to one part of copper sulphate in making the mixture.

(5) Use moderation in spraying. Since the injury increases with the amount of copper sulphate, an excessive application that leaves, by evaporation, larger amounts of the chemicals on the tree will be more harmful than lighter applications. Spray to cover the foliage and fruit with a thin film and yet not have the trees drip heavily.

(6) Avoid spraying in rainy, foggy, damp weather. Applications made just before showers are quite certain to produce injury; hence the Bordeaux mixture should be used, as far as possible, only in dry weather. If necessary to spray in wet weather it may be advisable to increase slightly the proportion of lime in the mixture.

In general it is pointed out that while spray injury is a serious matter, apple scab is worse, and "no fruit grower can afford to give up the use of Bordeaux mixture in fighting apple scab."

GLUTEN FLOURS AND SIMILAR FOODS.[a]

When wheat flour is made into dough and frequently washed, preferably in running water, the starch may be removed, leaving behind a tenacious gummy mass known as gluten, which contains practically all of the nitrogenous material originally present in the flour. This may be dried and ground or manipulated in various ways, and gluten goods are manufactured on a commercial scale and sold under such names as wheat gluten, gluten flour, etc. The experiment stations have examined such goods, which are widely used by persons suffering with diabetes and others who are compelled to exclude starch from their diet, and it has been found that they vary very greatly in quality. For instance, some of the products examined by the Maine Experiment Station were found to contain practically the same amount of protein and only a very little less starch than ordinary

[a] Compiled from Connecticut State Sta. Rpt. 1906, pt. 2, p. 153; Maine Sta. Buls. 55 and 75.

wheat flour, while other goods showed a high percentage of protein and a low carbohydrate content.

An extended study of the composition and nutritive value of gluten flours, gluten bread, and similar goods, nut products, soy-bean meal, and other commercial diabetic foods and homemade gluten rolls and soy-bean rolls was recently carried on by the Connecticut State Experiment Station. According to A. L. Winton's report of this work, all the samples of flour and meal examined, except the wheat and barley goods, the soy-bean meal, almond meal, nut meal, and the flours purporting to be made from milk casein, "were shown by microscopic examination to be wheat products."

The samples with less than 15 per cent of protein had the appearance of being untreated mill products with or without the bran coats and germ. Some were gritty—that is, felt rough between the fingers as compared with ordinary wheat flour, which feels soft and smooth. The starch was nearly or quite normal in its appearance under the microscope, showing that it had not been gelatinized as in the manufacture of true gluten flour.

The gluten flours and other flours made from wheat containing 26 per cent and upward of protein showed under the microscope flakes of crude gluten—i. e., a dried mixture of gluten and starchy matter, the latter in some cases being gelatinized. Some of the samples consisted entirely of this material, while others contained in addition what appeared to be untreated flour with normal starch grains.

The samples claimed to be wheat and barley, soy-bean meal, and almond meal were true to name.

The [commercial] bread, biscuit, and rusks for the most part showed under the microscope only wheat starch distorted by cooking, wheat tissues, and, in the case of those with high protein, gluten flakes like those found in the flour. * * * Calculated to the water-free basis, nearly all the samples guaranteed to contain a certain percentage of protein fulfilled the claims of the manufacturers.

All of the wheat preparations contained a certain amount of starch, although in most of them the percentage was considerably reduced. The beneficial results from their use are not due solely to the reduced percentage of starch, but also to the increased percentage of protein. The products are "richer" or "heartler" and the patient eats less of them. For example, ordinary wheat flour contains about 75 per cent of starch and 11 per cent of protein, whereas some of the diabetic flours examined contain about 50 per cent of the former constituent and about 40 per cent of the latter. Pound for pound, the amount of starch is reduced only to two-thirds the original amount, but the protein has been increased nearly fourfold, so that 25 parts of the preparation contain as much protein as 100 parts of the original, but only one-sixth (one-quarter of two-thirds) as much starch. But a gluten flour with any considerable amount of carbohydrates (for example over 10 per cent) should be used in very small amount, if at all, by diabetics. A safe flour for those suffering with the disease is casein flour entirely free from carbohydrates, or else a vegetable flour containing the smallest possible amount of these substances, such as may be prepared from soy beans by simply grinding with removal of the hulls, from almonds and other starch-free nuts after expressing a portion of the fat, or from wheat after washing sufficiently to remove nearly all the starch. A guar-

antee as to protein and starch content should be furnished with each product, so that physicians can calculate dietaries for their patients.

[The homemade gluten biscuits and the homemade soy-bean meal biscuits] contained comparatively low percentages of nitrogen-free extract. Although the soy-bean biscuit contained about four times as much nitrogen-free extract as the gluten biscuit, it should be borne in mind that * * * only about one-third the nitrogen-free extract of the soy-bean meal is starch, sugar, and dextrin, also that the nitrogen-free extract as given for the gluten foods is too low owing to the use of an erroneous factor for protein. With our present knowledge it may be safe to assume that both biscuits are about equally unobjectionable so far as their carbohydrate constituents are concerned. They are, however, of a very different nature as regards protein and fat, the soy-bean biscuit being relatively rich in fat, whereas the gluten biscuit is rich in protein. Practical trials alone can decide which is the more wholesome. It seems probable that both can be used to advantage, thus serving to relieve in a measure the monotony of the diet.

As regards the use of foods with little or no starch, the following statements are made:

The necessity of excluding so far as possible from the diet of diabetic patients sugars and substances, such as starch and dextrin, yielding sugar with the digestive juices, has led to the introduction of saccharine and other coal-tar derivatives and preparations containing, or purporting to contain, no starch or starch derivatives, or else diminished amounts of these substances. The craving of the patient for sweets is sometimes satisfied, at least temporarily, by the use of saccharine, a coal-tar product several hundred times as sweet as sugar which is free, so far as diabetes is concerned, from the injurious properties of sugar, but the preparation of a harmless but palatable substitute for bread requires a special flour containing a relatively small percentage of starch and special methods of breadmaking.

So-called diabetic flours may be made from wheat flour by washing out a portion of the starch and drying. If the process of washing is carried far enough, crude gluten is obtained containing very small amounts of starch, and from this, after drying, may be prepared gluten flour. Crude gluten, obtained as a by-product in the manufacture of wheat starch, is said to be utilized for the preparation of gluten flour as well as a concentrated cattle food. The removal of so large a proportion of the starch materially alters the physical characters of the flour and the bread made from it is quite different from ordinary bread. * * *

Most of the commercial diabetic flours, however, are not true gluten flours, since they still contain a considerable amount of starch—some of them so much as to render them positively dangerous for diabetic patients.

Not only all of the cereal grains but also most of the seeds of the legumes, such as field and Lima beans, peas, and lentils, contain large amounts of starch and must be avoided by diabetics; the soja or soy bean, however, is a striking exception as it contains, when ripe, no true starch, or only traces. This leguminous seed is an important food in Japan and is being used in this country for the manufacture of meal for the use of diabetics. * * *

The peanut, another leguminous seed, although very rich in oil, contains about 11 per cent of starch, sugar, and dextrin, of which about half is starch.

Most of the nuts, including walnuts, Brazil nuts, almonds, and filberts, since they contain no starch and only small amounts of sugar and dextrin but are

rich in protein and oil, are valuable additions to the diet of diabetics. Almond meal is used in the preparation of various biscuits and bread substitutes. The chestnut is a notable exception among nuts, in that it is rich in starch and poor in fat, the composition of the shelled nut being much the same as that of wheat flour; it is therefore entirely unsuited for the use of diabetics.

Casein prepared from skimmed milk is used for making a kind of bread entirely free from starch. * * *

In making out dietaries for diabetic patients it should be borne in mind that starch, sugar, and dextrin are all about equally injurious, since starch and dextrin are converted by the saliva and pancreatic juice into sugar (chiefly maltose) and it is the sugar, not the starch itself, which is directly injurious. For example, changing a portion of the starch into dextrin, as is done to some extent by toasting bread, does not render it less injurious; in fact it actually hastens the formation of sugar through the action of the digestive juices, since dextrins are intermediate products in the change. For this reason the sum of the percentages of starch, sugar, and dextrin, and not the starch alone, should be considered in valuing diabetic preparations.

Investigations like those noted above have a decided value, as they furnish information regarding the character of food products in which a great many persons are interested. It should be remembered, however, that those who, for any reason, must exclude starch from their diet should follow the advice of a competent physician and should not depend upon general information and their own opinions in regulating their food.

LAXATIVE PROPERTIES OF WHEAT BRAN.[a]

The laxative properties of bran have long been recognized in the very general use of bran mash to correct a tendency to constipation in farm animals, but the exact reason for this action of the bran has never been clearly understood.

Some recent experiments by W. H. Jordan, E. B. Hart, and A. J. Patten, of the New York State Experiment Station, indicate quite positively that there is a laxative action due to a soluble phosphorus compound known as phytin, which occurs in considerable amounts in the bran, for when cows were fed bran from which this compound had been largely removed by washing they showed a decided tendency to constipation besides other physiological disturbances.

The results obtained in these experiments, while not considered in any sense conclusive, seem also to have an important bearing on human nutrition.

It is generally believed—how correctly is not definitely established—that whole-wheat bread is a desirable food for persons of a constipated habit. This supposed influence is usually attributed to the effect of the coarser material upon the peristaltic action of the intestines. The outcome of this investigation very naturally suggested the thought that if whole-wheat bread really possesses the laxative properties assigned to it, this may be due to the amount of phytin it carries rather than to its mechanical condition. * * *

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[a] Compiled from New York State Tech. Bul. 1.

The phosphorus compounds of the wheat kernel are found mainly in the outer coatings and germ from which are derived the bran and middlings. As the bran phosphorus is mostly contained in the compound phytin, it is self-evident that this substance exists in much larger proportion in the whole-wheat bread than in fine flour.

Phytin is widely distributed in nature and has been found in the seeds of the red fir, pumpkin, peas, beans, white and yellow lupines, and potatoes, as well as in wheat.

EMMER AS A FEEDING STUFF.[a]

As fully explained in an earlier Farmers' Bulletin of this Department, emmer, which is a species of wheat (*Triticum dicoccum*), often incorrectly called speltz, was introduced from Russia into the northwestern United States, more particularly Minnesota and the Dakotas, where it has been so successful, especially for dry-land planting, that its culture and use have assumed considerable importance. J. W. Wilson and H. G. Skinner, of the South Dakota Station, say of this grain that "although better adapted to the more arid regions [it] has produced a yield of 63 bushels to the acre on the low land of the college farm. It is now quite generally grown as a grain crop and is highly spoken of wherever fed to live stock."

The characteristics and culture of this crop are fully treated in the Farmers' Bulletin referred to. The purpose of this article is to summarize investigations recently reported by the Minnesota and South Dakota stations, relating to its composition, digestibility, and general feeding value for different classes of farm animals.

The composition of emmer, as compared with other common cereals, is shown in the following table:

Composition of emmer and other cereals.

Kind of grain.	Analyst.	Water.	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Unhusked emmer grain as it came from the thrasher.	Snyder, Minn. Station.	10.88	10.50	2.32	60.71	11.70	3.89
Do	Shepard, S. Dak. Station.	10.17	11.58	2.46	61.40	11.45	2.96
Husked emmer	Shepard	10.03	11.69	2.80	70.70	2.94	1.84
Emmer husks	do	8.12	2.39	1.48	41.54	39.02	7.45
Wheat		10.50	11.90	2.10	71.90	1.80	1.80
Barley		10.90	12.40	1.80	69.80	2.70	2.40
Oats		11.00	11.80	5.00	59.70	9.50	3.00

The table shows that unhusked emmer is very similar in composition to oats; the husked emmer more closely approaches barley in chemical composition. In experiments made by H. Snyder, of the

[a] Compiled from Minnesota Sta. Bul. 99; South Dakota Sta. Bul. 100. See also U. S. Dept. Agr. Farmers' Bul. 139.

Minnesota Station, with sheep, unhusked emmer showed a high digestibility, the digestible nutrients in 100 pounds of emmer as compared with other cereals being as follows:

Digestible nutrients in 100 pounds of emmer and other cereals.

Kind of grain.	Protein.	Fat.	Carbohydrates.
	Pounds.	*Pounds.*	*Pounds.*
Emmer (unhusked)	9.11	2.14	68.40
Barley	8.70	1.60	65.60
Oats	9.20	4.20	47.30
Spring wheat	10.20	2.70	39.20

As measured by chemical composition and digestibility, as determined in the above experiments, emmer should have a high feeding value. Nevertheless, in the actual feeding experiments that have been made this grain has hardly shown as high nutritive value as would be expected from its composition and digestibility.

Summarizing the experiments which have been carried on for several years at the South Dakota Station with all of the more common kinds of farm animals, J. W. Wilson and H. G. Skinner report that in experiments in fattening sheep it required 5.09 pounds of barley as compared with 7.47 pounds of emmer to produce a pound of gain. In comparison with eight other feeding rations in experiments with lambs, it required 7.2 pounds of unground emmer or 8.3 pounds of ground emmer as compared with 5.3 pounds of corn to produce a pound of gain.

In fattening experiments with range lambs emmer was fed as a single grain and mixed with corn, barley, and wheat, half and half by weight. It was found that it required from 1 to 2 pounds more of emmer than of the other grains to produce a pound of gain. The lambs fed a mixture of emmer and barley, half and half by weight, made a larger gain for feed consumed than the average of the two lots fed on barley and emmer fed separately. This was also true of the lambs fed corn mixed with emmer in the same proportions as above. The results thus indicate that the emmer had a greater feeding value for lambs when mixed with other grains than when fed alone.

In feeding experiments with dairy cows it required 2 pounds more of emmer to produce a pound of butter fat than it did of barley or corn, other conditions being equal. The cows made a gain in weight of 18 pounds per head during the period. They consumed one-third more of emmer per head daily than did the lots receiving barley or corn. The cows did well on the emmer ration.

In an experiment in feeding for the production of baby beef emmer was used as one of the grain rations, with the result that the lot

fattened on this grain made an average daily gain of 1.69 pounds, while the lot fattened on corn made an average daily gain of 1.84 pounds. During the grazing period the lot fed on emmer gained 112 pounds more than that fed on corn. It required only 5.16 pounds of emmer for a pound of gain, as compared with 7.03 pounds of corn to produce a pound of gain during the grazing period.

The lot fed on emmer did not consume as much hay per pound of gain as did other lots, indicating that the husk of emmer is a good substitute for hay.

Emmer produces a hard fat, about the same as oats, and as good a quality of meat as corn.

With the exception of the emmer lot, the spayed heifers brought the same price as the steers. In this case a reduction of 50 cents per hundred was made on account of the spayed heifer being smaller than the steers in the lot which brought $6 per hundred.

The lot of calves fattened on emmer sold for 40 cents a hundred less on the Chicago market than did the lot fattened on corn, and dressed 2 per cent less than did the corn lot.

In experiments with 2-year-old grade steers it was found that a pound of corn was equal to 1¼ pounds of emmer. Where the corn and emmer were mixed half and half by weight the relation is about the same with a small increase in gain in favor of the mixture. With hogs it required 7 to 8 pounds of emmer, as against about 5 pounds of corn, to produce a pound of gain. Other experiments showed "that there was very little feed for swine when following steers fed on ground emmer."

The results show, in general, that while emmer has a high nutritive value it is hardly equal to corn in this respect. The economy of its use as feed will depend upon its availability and cost.

ROOTS FOR FARM ANIMALS.[a]

Roots as a part of the ration have a decided value for all kinds of domestic animals. Prof. T. F. Hunt and associates, in a recent bulletin of the New York Cornell Experiment Station, in discussing this subject, call attention to the fact that their effect is tonic as well as nutritive, and that breeders and feeders of farm animals for exhibition purposes find roots invaluable.

For most purposes the roots are chopped or sliced before feeding. Various hand and power machines are on the market for this work. Generally speaking, roots should not be fed alone, as they carry too much water. A feed may vary from 25 to 50 pounds per day for a thousand pounds of animal, according to the amount of dry concentrates and roughage fed. It is usual to put the cut roots into the feed box and distribute the ground grain over them. For poultry, however, the whole roots may be given, allowing the fowls to pick them. It is said by some that turnips and ruta-bagas impart a flavor to milk. However, if no roots are in the milking room at the time of milking and they are fed just after milking this may be avoided.

[a] Compiled from Michigan Sta. Bul. 240; New York Cornell Sta. Buls. 243, 244.

In feeding experiments at the Michigan Experiment Station, in which roots were fed at the rate of 15 to 20 pounds in addition to a silage and grain ration, R. S. Shaw and H. W. Norton, jr., found that—

The addition of roots to an already complete ration of silage, clover hay, and grain, for a dairy cow, stimulated both milk and butter-fat production.

The cost of the ration, however, was raised to such a degree as to lessen the profit of production, milk costing 4.2 cents more per hundred pounds, and butter fat 1.1 cents more per pound, as a result.

In case a large production is desired, as in making records, roots might be used to advantage.

The cows gained in weight more on the root ration than when fed without roots, but the difference was not great.

The percentage of butter fat in the milk was constant, whether on the "root ration" or without roots.

The roots and tubers most commonly used for feeding farm animals in this country are potatoes and sweet potatoes, beets of different sorts, mangel-wurzels, ruta-bagas and turnips, carrots, parsnips, and artichokes. Many analyses of these roots have been reported in publications of the experiment stations, and the average figures given in the following table are based upon such work:

Average composition of roots and tubers.

Kind of roots.	Water.	Protein.	Fat.	Carbohydrates.		Ash.	Fuel value per pound.
				Starch, sugar, etc.	Crude fiber.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Artichokes	79.5	2.6	0.2	15.9	0.8	1.0	360
Red beets	88.5	1.5	.1	8.0	.9	1.0	195
Sugar beets	86.5	1.8	.1	9.8	.9	.9	230
Carrots	88.6	1.1	.4	7.6	1.3	1.0	195
Potatoes	78.9	2.1	.1	17.3	.6	1.0	365
Sweet potatoes	71.1	1.5	.4	24.7	1.3	1.0	215
Parsnips	83.0	1.6	.5	11.0	2.5	1.4	295
Mangel-wurzels	90.9	1.4	.2	5.5	.9	1.1	150
Ruta-bagas	88.6	1.2	.2	7.5	1.3	1.2	190
Turnips	90.5	1.1	.2	6.2	1.2	.8	160

As will be seen from the above table, the roots and tubers are succulent foods—that is, they contain a large quantity of water in proportion to their nutritive material. Their feeding value depends in large measure upon the carbohydrates, chiefly starch, which they supply, though the ash constituents are of undoubted value.

The data obtained in investigations reported in the Cornell bulletin referred to on the value of root crops for stock feeding are based on extended experiments on the total dry matter yield per acre of a number of the more important root crops. The results obtained indicate that such root crops as mangel-wurzels, beets, carrots, ruta-bagas, and turnips yield a profitable stock feed under usual conditions.

A greater average yield of dry matter per acre may be obtained from mangels, half-sugar mangels, sugar beets, and ruta-bagas than from an average yield of corn. While it costs somewhat more per pound to produce this dry matter, yet it is quite probable that the higher digestibility and palatability of roots offset this lesser cost of corn. * * *

Comparing mangels and sugar beets, the former are more succulent, while the sugar beets produce a higher average yield of dry matter. It should be remembered, however, that because the sugar beets grow into the ground they are more difficult to harvest, and, furthermore, they do not keep so well as mangels. It may seem that the yield of sugar beets is more uniform than that of mangels, but this is due to the fact that the yield of different varieties of mangels varies more widely than that of the varieties of sugar beets.

The ruta-bagas produce profitable yields of food material, and the fact that they are well adapted to early feeding, and also to the feeding of swine, as well as to sheep and cattle, adds to their value.

Turnips, as a general rule, do not yield as well as the above-mentioned roots, and, furthermore, they are more liable to attacks of disease. However, they are useful for early feeding, and are especially valuable for sheep.

Carrots and parsnips, while yielding a fair percentage of dry matter, do not yield a sufficient quantity of food material to warrant general planting for stock feeding. However, they are exceptionally good as a condimental food, and for horses.

The results of the experiments carried on in 1904–5 at Cornell, the authors believe, show plainly that early planting of roots for stock feeding is desirable. "Ruta-bagas, however, may be planted a little later than the others. It has not been shown that the more fibrous and heavier ruta-bagas of a longer-growing season are less digestible or palatable than the more succulent roots of the shorter-growing season."

The proper methods of harvesting and storing roots are obviously of the utmost importance in the use of such crops for winter feeding. The deductions from the New York Cornell Station experiments which have to do with this subject follow:

Roots are generally harvested by hand, except in the case of the sugar beets, when a plow may be used to raise them from the ground. When turnips, ruta-bagas, and mangels are grown for succession feeding, the turnips are generally harvested first, before frost. Slight frosts in the late fall will not injure ruta-bagas or mangels, although the first frost should be a sign of harvesting time unless it be exceptionally early and very sure to be followed by later warm weather. In late summer and early fall the tops do not grow much, yet the roots are developing and ripening rapidly.

In the case of mangels, ruta-bagas, and most turnips the plants can be pulled by hand, the tops twisted off as they are pulled, and the roots piled or thrown directly into the wagon. It is thought that piling and afterwards loading is less fatiguing than throwing the roots directly into the wagon as pulled. The roots should reach their place of storage with as little dirt and bruising as possible.

Roots may be stored in a cellar or in a pit in the field. The cellar is the better whenever practicable. It may be a part of the barn structure, or built under the driveway of a bank barn, or it may be built as a dugout in a side-

hill near the barn. Perhaps concrete is the best material for construction. It should be not over 7 or 8 feet deep and large enough to hold the yield or supply. It is best to have it located and constructed in such a way that the roots can be dropped in from above, preferably through trapdoors in the bottom of the wagon and the roof of the cellar. It is essential that the walls (if built in the ground) and the floor have good drainage and that ventilation be provided through the top, and that the construction be frost proof. The ventilators should be left open until sweating has ceased, when they may be closed for the winter. In winter the cellar should be kept closed as much as possible on warm days. Roots should be so placed that turnips may be fed first, ruta-bagas next, and after these mangels and carrots.

If stored in a pit in the field, a high, dry place should be chosen. If the ground is clayey, the roots should be placed on top of the ground; if it is gravelly and drainage is good, a shallow pit about 5 feet wide and of necessary length may be shoveled out. The roots should be carefully placed in a gable-shaped pile about 5 feet wide and as long as convenient. A thin layer of straw should then be laid over the pile and this covered with 6 to 8 inches of earth. Another and thicker layer of straw and a final layer of earth will complete the work. Ventilators should be placed at intervals of 10 or 15 feet, which should be closed when sweating has ceased. The pit should not be opened on warm days in winter. A ditch for drainage should be cut around the pit. Roots stored in this way do not keep as well as when stored in a good cellar, therefore they should be fed out as early as possible.

A later bulletin (No. 244) of the New York Cornell Station gives in detail the best methods of growing different varieties of root crops for stock feeding.

CABBAGE AS STOCK FEED.[a]

In a recent bulletin of the New York Cornell Station S. Fraser says: "In the search for good succulent feed for live stock, the cabbage should not be overlooked. For this purpose the cabbage is to be compared with roots." It is stated that the only kind of cabbage grown in New York for stock feeding "is the common or heading cabbage, usually spoken of as 'cabbage,' and the one kind which is understood when this term is used. The Savoy is used for stock feeding in Europe, but not in America, so far as known to the writer. The cabbages, kales, turnips, rape, and kohl-rabi are closely related. * * * Among the kales practically none are grown in America, although the British farmer is extending his acreage of the thousand headed cabbage or kale, and other forms are grown in parts of Europe. That none of these latter are of value to this country hardly seems possible and, no doubt, in time some will receive a fair trial."

As high as 50 tons per acre of crop yielding nearly 4 tons of dry matter containing about 1 ton of nitrogenous matter was obtained in the Cornell experiments. The essentials for a high yield are a rational rotation to prevent the soil from becoming infected with the

[a] Compiled from New York Cornell Sta. Bul. 242.

club-root fungus, early planting to give time for full growth and development of the heads, and uniform stand of from seven to ten thousand plants per acre.

The cabbage differs from almost every other farm crop in that its successful production is little influenced by the type of soil on which it is grown. It shows a wide range of soil adaptability and it can be grown on almost any type of soil provided it is well supplied with organic matter, is in good physical condition, and supplies an adequate amount of water. A loose friable soil well prepared by deep fall plowing and manured with 10 to 20 tons of barnyard manure per acre before plowing, followed by an application of 1,000 pounds of quicklime per acre after harrowing in the spring, is considered well adapted to large yields of cabbage.

The plants must never receive a check. Three or four days after transplanting or after thinning they should receive an application of 50 pounds of nitrate of soda per acre; this may be applied near the rows with a drill if feasible, or be sown broadcast and harrowed in at some time when the leaves of the plants are dry, for if they are wet and it dissolves on the leaves it will burn them. This application may be repeated twice more, at intervals of from ten or fourteen days, making a total application of 200 pounds of nitrate of soda per acre; even 300 pounds may frequently be used with profit. No crop will give better returns for such treatment and for clean and constant culture. The nitrate of soda aids leaf growth at a time when one green worm may eat a cabbage a day, and forces them through this critical period.

The following varieties were tested at the Cornell Station and all gave good results: Surehead, Volga, Autumn King, and Danish Ball.

Volga led in the proportion of heat to total plant, and it kept better than Surehead or Autumn King. Autumn King seemed to be better suited to clay loam soil than gravel loam. Surehead did better than Autumn King in 1904 on gravel loam. Danish Ball is the lowest in yield, but has compact head. * * *

Cabbages are good food for cattle, sheep, and swine. When they are grown for stock feeding it has not been a general practice to remove them from the field. If it is convenient for feeding to continue into early winter they are pulled and piled closely, then fed directly from the field. When fed to sheep they are generally not cut. The sheep can nibble them very well. When fed to cattle they should be cut either by a cutting machine or they may be chopped fairly well with a square-pointed shovel. They should be fed as soon after being cut as possible. Sometimes the grain or chopped feed is mixed with them.

It is claimed by many feeders that cabbages are likely to lend a disagreeable odor or taste to the milk when fed to dairy cattle. This may be avoided, however, by feeding just before or just after milking, care being taken to remove the milk from the presence of the cabbage as soon as possible.

The following methods of storing the cabbage are described:

Method 1.—One of the simplest ways is to store in an orchard or some sheltered place, often alongside a fence which has been made tight by a liberal use of straw. The cabbage are stored with their stems on and are placed head down and as close together as possible. Two or three tiers are often made, the heads of the second tier being placed between the stems of the lower, and so on, the

piles being made of any width and length desired. The whole is covered with leaves, salt-grass hay, or straw and a little soil, rails, brush, or litter. Small unsalable heads when stored in this way in November will continue to develop during winter and frequently sell as well as any in February.

Method 2.—Small quantities may be stored by plowing out two or three furrows, 10 or 12 inches deep, on a well-drained site, and placing the heads with their stems up as close together as possible. Some prefer to lay them but one or two thick, while others will pile them up 2 to 2½ feet high, bringing them to a point. The pile is then covered with straw, salt-grass hay, or a thin layer of straw, and then several inches of soil. They are stored before freezing, and when the soil covering them is frozen it may be covered with strawy manure or any other litter to keep the soil frozeu until the cabbages are needed for sale.

Method 3.—Large quantities are stored in cabbage houses, this being the best way commercially for a large part of the State. The houses are often built alongside the railroad in order to facilitate shipment, but a small one can be built on the same principle if desired. The walls are frequently about 8 feet high at the eaves, built with three walls and two air spaces, papered on the outside, with a close-boarded and tar-papered roof. The building may be 50 feet wide and of any desired length, with a driveway through the center and well provided with ventilating arrangements. The building is divided into compartments or bins, which run across the house from the driveway to the wall, one on each side. These are 5 feet wide, made of slats on 4-inch studding. This permits of a 4-inch air space all round each bin, the end near the outside wall included. The floor of the bin is raised from the ground about 10 inches, and is also made of slats, thus securing free circulation of air. When the bins are filled, the driveway may be filled if desired. The heads are cut close, practically ready for shipment, and are piled in the bins from the floor to the ceiling. The filling is done in cold weather, if possible, and care is required in ventilating to keep the temperature of the building as near 30° to 35° F. as possible, opening during cool nights and keeping it closed on warm days or when cold snaps occur.

Method 4.—One or two carloads may be stored in the following manner: Select a dry site, excavate about 1½ feet deep and 9 feet wide and of the desired length. Set posts in each corner and every 4 or 5 feet along the side, letting them project about 4 feet above ground level. Board up the inside, 16-foot boards being useful. Set 2 by 4 inch rafters on the studding and roof with wide boards, lapping them a little. Cover the apex of the roof with two boards fastened together like an inverted V. Bank up the outside of the house, and in cold weather cover the roof with straw or horse manure.

PASTURING HOGS.[a]

In a bulletin of the Mississippi Station E. R. Lloyd discusses the subject of hog raising from the standpoint of Mississippi conditions, but states some facts which have a wider application, especially in the South. He points out that Mississippi now imports about 50 per cent of the pork consumed in the State, while with the facilities for producing cheap feed there should be an export of hog products.

There are some features in hog raising that should appeal to every thoughtful farmer. No other meat-producing animal is capable of producing so many young in a year. In our mild climate, where suitable pastures can be provided

[a] Compiled from Mississippi Sta. Bul. 100. See also U. S. Dept. Agr., Farmers' Bnls. 56, p. 6; 84, p. 18; 124, p. 25; and 276, p. 20.

for nearly every month in the year, the sow should farrow twice annually, producing one litter in early spring which can easily be made ready for the late fall or early winter market, and another litter in early fall to be made ready for the spring market. The small amount of capital required to begin with and the quick returns on the investment should make hog raising especially attractive to the small farmer with limited means. The hog will make a pound of gain on less food than most live stock, and will profitably utilize the waste products around the farm, dairy, and kitchen.

At present there is a strong demand at very attractive prices for what is known as the light market hog, weighing from 130 to 150 pounds. A hog of this weight can easily be produced with ordinary care at from 4 to 6 months old.

No man should attempt to raise hogs without adequate pastures. For pastures woven wire is the best fencing material, all things considered. Around the field to be used for pasture run a woven-wire fence 30 inches high with three strands of barbed wire above. This fence will not only turn hogs but other live stock.

For convenience in preparing the land and planting the crops, it is best not to divide the pasture up with permanent fences. When the crops are ready for the hogs, by using the hurdle or portable fence the field may be divided into lots of any size. The hurdle fence is simple and cheaply made, and when not in use can be taken down and stored under a shed until needed again.[a]

There is a mistaken idea held by some that alfalfa, red clover, rape, and similar crops will produce profitable gains when pastured without grain. The practical trials made at many experiment stations prove this not true. Of the many forage plants, alfalfa is one of the most satisfactory for hogs, since it can be made a permanent pasture and is rich in protein, making an excellent combination with corn. The leaves are tender and the stem small, which make it easily masticated and it is very much relished.

At the Mississippi Station careful tests have been made to determine the value of alfalfa pasture without grain for hogs. Pigs ranging in age from 3 to 24 months have been used, and the results of two years' work show that alfalfa is little more than a maintenance ration for growing hogs without grain. Satisfactory gains have always been secured from alfalfa pastures by supplementing the pasture with from 1 to 2 per cent of the weight of the hogs in corn or other grain.

Cowpeas without grain so far have given better results than any other crop for hog pasture. In one test the crop was grown on thin hill land, where 1 acre of cowpeas produced 350 pounds of pork. In another test on rich valley land 1 acre of cowpeas produced 483 pounds of pork. The hogs were put in the field when the peas were about ripe.

CULL BEANS AS A FEED FOR HOGS.[b]

Beans are a very important agricultural crop in Michigan, the total crop ranging between 1,500,000 and 5,000,000 bushels per year. It has been estimated that from 5 to 10 per cent of the total crop consists of culls or damaged beans, the proportion being influenced by the peculiarities of the season and weather conditions at the time of harvest. Of these cull beans about one-half are probably used for feeding purposes.

[a] For construction of hurdles, see U. S. Dept. Agr., Farmers' Bul. 78, p. 12.

[b] Compiled from Michigan Sta. Bul. 243.

R. S. Shaw and A. C. Anderson, of the Michigan Experiment Station, who have recently studied the value of cull beans as a feed for young pigs and for fattening pigs, state that—

> Mixed with other grains, cull beans may be fed to sheep, and large quantities are used in this State for this purpose each year. It is reported that they are used as a food for dairy cows; they are also fed to swine. * * *
>
> It is not desired to advocate the extensive use of beans as a swine food, especially in the fattening or finishing period. Pork from hogs which have been fattened quite largely on beans is generally soft and lacking in quality. If a considerable portion of the pork produced in the State were of this kind it would lower prices and work serious harm to the swine industry. It is generally conceded that bean-fed hogs store up a fat having a lower melting point, and consequently a softer fat, than hogs fed upon many other feeds, and that a considerable portion of the element called quality in pork is dependent upon the melting point or character of the fat stored up.
>
> In the case of mutton finished upon beans no such criticism has been made, probably because there is relatively less fat in the carcass of the sheep, and its character is not so essential to the quality of the meat as in the case of the pig.

In the Michigan experiments the cull beans used were cooked in two ways: "The one by injecting live steam into a barrel containing the food to be cooked, the other by the use of the ordinary feed cooker, consisting of a caldron kettle, with a cast-iron stove as a jacket for the same. A large variety of cookers of similar sorts are upon the market. In cooking small amounts, the kettle gave the better results, while the steam was more convenient for larger quantities."

When cooked beans mixed with corn meal in the proportion of 3:4 were fed for ten weeks to pigs weighing on an average 50 pounds there was an average daily gain of 0.95 pound per head at a cost of 2.8 cents per pound. "It was apparent that the food combination, while it possessed the proper amounts of carbohydrates and protein, was not well enough adapted to the requirements of the pigs to produce adequate growth. It was thought that the introduction of a less concentrated food factor would give variety to the ration, and at least a physical composition better suited to the age and digestive powers of the pigs." Accordingly, middlings were substituted for a part of the beans in a trial made with two lots of five similar pigs weighing on an average 73 pounds, and covering ten weeks, the ration consisting of cooked beans, corn meal, and middlings 2:3:2. The average daily gain was 1.34 pounds per head per day, and the cost of a pound of gain 3.1 cents.

Check tests made with two lots of similar pigs fed a ration of sour skim milk and corn meal 5:1 showed an average daily gain of 1.34 pounds per head at a cost of 3.7 cents per pound of gain.

When cooked beans alone and mixed with corn meal 1:1 were compared with pigs averaging 150 pounds in weight, three lots fed beans only made in eight weeks an average daily gain of 1.1 pounds per

head, 4.21 pounds of beans at a cost of 2.53 cents being required per pound of gain. On beans and corn meal the average daily gain was 1.52 pounds and the cost of a pound of gain 3.25 cents, 4.1 pounds of the bean and corn meal mixture being required per pound of gain.

It would appear that hogs of the weights and ages of those fed in this experiment could reasonably be expected to make a gain of about a pound per day on a ration consisting of beans only, and that the same sort of hog could reasonably be expected to make a gain of about 1½ pounds per day if an equal amount of corn were supplied with the bean ration. Further, it would appear that the gains made by the bean-fed hogs would cost about $2.50 per hundred pounds and those made by the beans and corn-fed hogs would cost about $3.50 per hundredweight.

If the cost of the additional labor and equipment is eliminated the gains made from the beans alone were cheap, but other factors must be taken into account and, when judged by experts, the bean-fed pigs were rated as being worth less per pound than those fed the beans and corn meal.

The general conclusion from the investigation seems to be that cull beans rightly used may be a valuable factor in pig feeding, but that excessive amounts should not be fed, as beans have a tendency to produce soft pork.

From many inquiries and reports received from the farmers of the State it was known that many were using beans alone for fattening swine. Some of these told of large gains and others of unsatisfactory ones. Some that had corn were even selling this and buying damaged beans, feeding these exclusively instead of making a combination of the two feeds. Such feeding must necessarily be accompanied with some losses of protein, and from the standpoint of food economy is open to considerable criticism. However, if the beans were cheap the practice might be financially allowable. When any feed is cheap and a large stock of it is on hand there is a great temptation to supply it too freely, and to feed it to the exclusion of other feeds which experience and judgment would suggest.

As regards methods of feeding beans, Professors Shaw and Anderson state that—

Beans can be fed to swine only in the cooked form. The pig seems to be unable to utilize beans which are at all hard or firm, even though they have been boiled for some time, hence it is very essential that they be thoroughly [and carefully] cooked. To supply a single feed of half-cooked beans to a pen of hogs robs them of their appetites and relish for their food, if indeed it does not put them off feed. * * *

The amount of water used will be governed somewhat by the way the beans are to be fed, whether they are to be mixed with other feeds or fed alone. In either case the water content of the ration should not be above the bodily requirement of the pigs fed. In fact, it is usually better to have the water content of the ration below the daily requirement of the pig and then allow the pig access to water at will or supply it regularly. When the food is excessively sloppy, the pig is compelled to consume unnaturally large amounts of the ration given in order to properly supply his bodily needs. This distends the stomach,

unbalances the whole digestive system, and makes a paunchy, ill-formed pig, and one which at slaughtering time yields a very low per cent of dressed carcass. Such feeding is neither good practice nor good economy. * * * All refuse grains contain more or less foreign material. Cull beans are no exception to the general rule, perhaps the most objectionable ingredient being the gravel stones. In some samples there was from 5 to 10 per cent of gravel stones. * * *

By the use of a hand fanning mill adapted for bean cleaning a considerable portion of the stones may be eliminated. * * *

It will be found advantageous to use some salt with every mess of beans cooked; about the same amount as would be used for human food would probably be sufficient [but it must be remembered that an excessive amount of salt may cause serious disturbance].

Salt is an appetizer and renders the food more palatable. It also possesses laxative properties, and on this account will be found valuable to use in connection with any ration containing beans. * * *

It is a general rule in all feeding operations that when any change is to be made in the ration of an animal it should be done gradually. This is especially applicable in the use of a ration containing any large quantity of beans.

In winter feeding it will be advisable to supply the feed while warm, but in the use of all warm feeds every pailful used should be stirred until at an even temperature and then tested with the finger. It is a cruel neglect to supply hot food to a hungry pig. Sore mouths, dislike of food, and apparent loss of appetite are sometimes traceable to no other cause. Such mistakes will sometimes occur unless the feeder adopts the plan of stirring and testing every pailful fed.

Pails used should be rinsed after each feeding, and especial care should be taken to clean the kettle or barrel after each cooking and not allow sour or moldy material to collect about the food receptacle.

HEALTHY POULTRY.[a]

Dr. C. A. Cary, of the Alabama College Station, makes the following suggestions regarding the maintenance of sanitary conditions in poultry raising and the treatment of certain common poultry troubles, which it is believed will be useful to those who are engaged in the business on either a large or a small scale. Pure water and wholesome feed are of course prime requisites. Of the first, Doctor Cary says:

Water.—The water supply for poultry should be the very best. Fresh water in clean, uncontaminated vessels should be kept constantly within reach of the chickens, or all kinds of poultry, especially during the hot weather. Good well water is preferable to running surface water. Protected earthen-ware vessels or any form of water vessel should be so constructed that it can be cleaned; in fact, it should be cleaned daily with boiling hot water.

The relation of the feed to health is thus explained:

Feed.—The feed is responsible for the health, growth, and flesh of poultry. Young chicks are often overfed and usually fed in filthy places or in unclean troughs or vessels. More young chicks die from overfeeding and sour, fermenting, decomposing feed than from any other cause. Especially is this true where

[a] Compiled from Alabama College Sta. Bul. 136.

mashes or liquid or moist feed is used. Some poultrymen use milk with bread or coarse meal in it. Milk is a good food, but if given to chickens it must be fresh or it should be boiled or cooked with the bread or meal in it and fed as soon as sufficiently cooled. Always feed it in clean vessels, not in too large quantities, and never leave the excess to sour. In feeding milk and all forms of moist feeds to chickens be sure to thoroughly clean and boil or scald out the feeding vessels once or twice per day during hot weather. Look well to the chick feeds. Many of them are made of refuse corn, wheat, sorghum, and other grains. As a rule it is best to make your own mixed grain feeds, and then you will know the quality of each grain ingredient and will not be compelled to pay grain prices for the heavy grit that is so plentiful in the average mixed chicken feed. It is cheapest and safest and best for the health and growth of the chickens or other fowls to buy the separate grains and the grit and do your own mixing.

The arrangement and management of the poultry houses and yards are shown to have a most important bearing upon the health of the occupants.

Arrangement and management of houses, yards, etc.—The chicken houses should be separated from all other buildings, and all the sides should be of lattice work or quite open during the summer. The north, east, and west may be closed during late fall and winter. The floors, roosts, and nests should be so arranged as to be readily removed, cleaned, and disinfected. Portable or movable chicken houses are useful if so built that they will not come to pieces when moved. In cases of infection with disease germs, or of infestation with mites, intestinal parasites, lice, etc., it makes the work of disinfection and eradication of parasites more easily and quickly and permanently done if the house can be quickly moved to a new uninfected locality.

Most chicken coops are too close, too heavy, and too inconvenient to clean. Some one should invent a "knock-down" brooding coop that can be cleaned readily, and one that will not easily break, and retain firmness and solidity when set up.

The yards and runs are usually too small and insufficient in number. Poultrymen can greatly lessen their work by having large yards or runs and many of them.

The placing of 20 to 40 chickens in a small yard (say 50 by 100 feet) and keeping them there eight to twelve months in a year is one of the means of intensifying the propagation of intestinal parasites of all kinds. The degree of infestation of a yard or run or poultry house depends upon the size, the number of poultry kept in them, the length of time poultry are kept in them, and, to some extent, on weather conditions. A large area, as a yard or pen, will not become alarmingly infested with intestinal or other parasites as quickly as a small area. Likewise, the fewer the birds and the shorter the time the birds are kept in a given place, the less, in degree, the infestation. This often explains why a man with very few chickens having good feed and wide range can raise fine, healthy birds. But when this same man attempts to raise a large number on a small range, yard, or run, he fails, and his chickens are less vigorous or healthy and consequently less profitable. The number of houses, coops, yards, and runs should always be in excess of the immediate demands. Suppose a man has yards, runs, houses, and coops for three different lots of chickens. He should at least have three extra yards and runs into which he could shift the disinfected houses, coops, and birds as soon as the other yards or runs became infested. It would be best to have yards and runs sufficient in

number to enable the poultryman to make three or four shifts before coming around or back to the first. This may seem extravagant, but it is the only means by which you can breed healthy, vigorous birds without an immense outlay in cleaning and disinfecting yards or runs. Immediately after vacating a yard or run, plow it up and seed it down to wheat, rye, oats, barley, cowpeas, sorghum, or anything that will make a growth upon which the chickens can graze when brought back to this yard or run. Young chickens should not be allowed to range over ground where old chickens run; if it be possible, have the young chicks in a pen or yard where no old chickens have been for six or eight months. This will prevent young chicks from becoming infested with roundworms and tapeworms.

Doctor Cary recommends that when new fowls are purchased they should be confined in some place remote from the flock for one to four weeks. This will give time to determine the presence or absence of such an infectious disease as fowl cholera, a precaution which may save the flock and avoid the difficulty of disinfecting houses and yards.

In spite of great care and strict observance of the precautions enumerated, however, insect pests and diseases may get into the flock and remedial treatment becomes necessary.

Insect pests and diseases.—Chicken mites are the most common pests in nests and houses. Cleanliness is the best means of preventing their multiplication. They develop best in filthy nests and in cracks and under boards in chicken house. Clean the house (move if portable) and then spray the house with kerosene oil emulsion. If possible apply tar in cracks and under roosting boards and this will catch many which escape the spray. Clean and spray the infested houses and coops once per week and dip the infested chickens in weak kerosene oil emulsion, or a 2 to 4 per cent creolin solution. Never dip chickens in a poorly mixed kerosene solution. It will blister the skin, if the kerosene is not thoroughly emulsified. Copper sulphate solution, if applied hot [to roosts, walls, etc.], will kill mites. It should not be applied on the chickens.

The following directions are given for the preparation of the kerosene emulsion and copper sulphate solution needed for the treatment recommended:

Kerosene emulsion.—Dissolve one-half pound of hard soap in 1 gallon of hot water, add 2 gallons of kerosene and stir or churn until a milky mixture (or emulsion) is formed; now add 8 to 10 gallons of water; stir or mix with a spray pump, or keep the first emulsion of soap, water, and kerosene and use as much of it as you desire after diluting with 8 to 10 parts of water.

Copper sulphate solution.—Dissolve 4 to 6 pounds of copper sulphate (bluestone) in 20 to 50 gallons of water. Spray this over dusted or cleaned boards, walls, nests, or other places. When dry, or the next day, whitewash with spray or brush. If applied hot this copper sulphate solution will kill mites.

Whitewash is used to a large extent in connection with poultry houses, and is an efficient means of filling small cracks and making smooth surfaces which can not harbor vermin. An excellent wash for this purpose is the so-called Government whitewash, which is prepared as follows:

Government whitewash.—Half a bushel of unslaked lime, slaked with warm water. Cover it during the process to keep the steam. Strain the liquid through a fine sieve or strainer. Add a peck of salt previously well dissolved in warm water, 3 pounds of ground rice boiled to a thin paste, and stir in boiling hot a half pound of powdered Spanish whiting (plaster of Paris) and a pound of glue which has been previously dissolved over a slow fire, and add 5 gallons of hot water to the mixture. Stir well and let it stand for a few days. Cover up from dirt. It should be put on hot. One pint of the mixture will cover a square yard if properly applied. Small brushes are best. There is nothing that compares with it for outside or inside work, and it retains its brilliancy for many years. Coloring may be put into it and made of any shade, Spanish brown, yellow, or common clay. To it may be added 2 pints of carbolic acid, which will make it a disinfectant.

Doctor Cary gives the following useful list of drugs needed by the poultryman and suggestions as to their uses:

FOR INTESTINAL WORMS.

(1) Isolate infested birds and destroy or disinfect their droppings while being treated.

(2) Put 1 to 2 drams of copper sulphate in each gallon of drinking water for one week; or

(3) Powdered pomegranate root bark (for tapeworms), followed by 2 or 3 tablespoonfuls of castor oil; or

(4) Oil of turpentine, 1 to 2 teaspoonfuls, followed in four to six hours with castor oil.

(5) Powdered santonin in 5 to 8 grain doses is especially good for roundworms.

(6) Chopped-up pumpkin seed for tapeworms.

FOR WORMS IN THE AIR PASSAGES.[a]

(1) Turpentine introduced by stripped feather into the windpipe.

(2) Steaming with creolin and turpentine in the hot water.

(3) Feeding garlic in the food.

FOR DIARRHEA.

(1) Subnitrate of bismuth, 1 to 4 grains, two to three times per day; or

(2) Pulverized chinchona bark, 1 to 2 grains three times per day, and

(3) Quinine one-eighth to one-half grain two times per day.

(4) Dry feed or cooked and slightly moist feed.

CONSTIPATION.

(1) Epsom salts, 20 to 30 grains in 1 tablespoonful of water; or

(2) Castor oil, 1 to 2 teaspoonfuls; or

(3) Calomel, 1 to 2 grains, and

(4) Soft feed.

FOR LICE.

(1) Lard or vaseline over head, under wings, and around anus.

(2) Dipping in 15 per cent kerosene-oil emulsion; or

(3) Dipping in 2 to 5 per cent creolin solution.

(4) Pyrethrum powder dusted among the feathers.

(5) Clean nests, yards, and houses.

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[a] U. S. Dept. Agr., Farmers' Bul. 84, p. 28.

FOR INTESTINAL DISINFECTANT.

(1) One-half to 2 drams of copper sulphate in 1 gallon of drinking water; or
(2) One-half to 2 drams of iron sulphate in 1 gallon of drinking water; or
(3) Salol, one-half to 1 grain, once or twice daily.
(4) Naphthol, one-half to 1 grain, once per day after eating.
(5) Resorcin, one-fourth to one-half grain, once per day after eating.
(6) Hyposulphite of soda, 4 to 10 grains in 1 tablespoonful of water.

FOR CHICKEN MITES.[a]

(1) Lard or vaseline on legs, feet, and head applied once or twice per week. Wash off scales.

(2) Kerosene emulsion sprayed on walls, roosts, floors, and nests once per week for what is commonly called chicken mites or chicken ticks.

(3) Two to 5 per cent creolin solution sprayed on same places as (2).

(4) Formalin, 1 part to 200 parts of water, sprayed as (2).

(5) Corrosive sublimate (very poisonous), 1 part to 1,000 parts of water, sprayed as (2).

(6) Boiling hot water freely applied by pouring over walls, roosts, nests, and floor.

(7) Clean chicken house every day until mites are gone.

Doctor Cary recommends that every farmer and poultryman should take one or more good poultry journals and should get all the publications on poultry issued by this Department and by the State experiment stations.

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[a] U. S. Dept. Agr., Farmers' Bul. 190, p. 6.

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